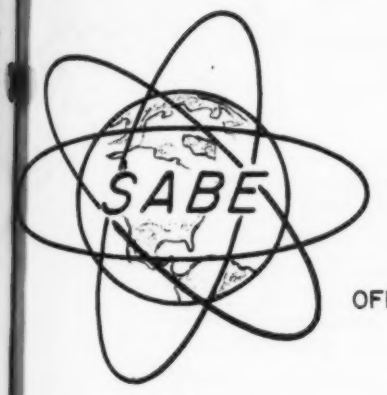

DATA PROCESSOR

FOR BETTER BUSINESS EDUCATION

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MEMBERSHIP DUES IN THE SOCIETY ARE $2 YEAR

Automation Research

The Society is endeavoring to gather and publish the most comprehensive listing of automation theses and dissertations in existence. Often research is completed and promptly forgotten, mainly because there is no single publication listing all theses and dissertations completed each year. While the Society for Automation in Business Education cannot undertake to publish such a listing in all fields, it does seek to provide a listing in the field of Automation. Previous issues of the SABE DATA PROCESSOR have carried a great number of titles. By using SABE Automation Research listings, prospective researchers can avoid duplication of effort and make a real contribution to knowledge of some area of Automation by researching an area not previously studied, or by expanding upon some topic which needs to be amplified. By using SABE Automation Research listings, users of research findings can keep themselves informed of new developments in the field.

If you are working on a theses or dissertation in the field of Automation, or if you know of someone who is, please send us a listing. This will help ensure that your work, or the work of a friend, is not completed only to gather dust on the shelves of some library. Editors of other publications watch the SABE Automation Research listings in order to obtain new writing talent for their magazines.

Please help to keep the SABE Automation Research listings up-to-date by sending listings, corrections, or other useful information on graduate research either completed or in progress. If you are teaching in a college or a university, or if you are living in an area near a college or a university library, please take the time to go and make a list of all theses and dissertations on automation which have been completed; and, in addition, please try to find out whether any graduate work on automation is in progress.

The following research is published in the DATA PROCESSING ANNUAL Punched Card and Computer Applications and Reference Guide, Volume 3, 1961, by Gille Associates, Inc., (now American Data Processing Inc.), 22nd Floor Book Tower, Detroit 26, Michigan:

Louis Fein (Palo Alto, California), THE ROLE OF THE UNIVERSITY IN COMPUTERS, DATA PROCESSING, AND RELATED FIELDS, pp. 180-188. The Abstract, as published in DATA PROCESSING ANNUAL, reads: "A study was made of university programs in the United States in the fields of computers, data processing, operations research, and other closely related fields. University policies, organization, administration, faculties, students, researches, curricula, equipment, and financing were investigated. An integrated university program is recommended reflecting the conviction that many present activities related to computers will develop into disciplines and as such are the legitimate province of the university scholar. Details on a recommended Graduate School of 'Computer Sciences' are given."

Fein's study is followed up in the DATA PROCESSING ANNUAL by a listing of DATA PROCESSING AND COMPUTER COURSES AT COLLEGES AND UNIVERSITIES (page 189) and a listing of PRIVATE SCHOOLS OF DATA PROCESSING (page 206). These listings are valuable to the prospective researcher because schools that have either an installation, or courses, or both, in the field of automation, are most likely to have students doing research in automation. By the same token, these schools are likely to be in position to offer the better courses of instruction to students desiring to study automation.

STANDARD EDP REPORTS

The first information service to provide rigidly standardized data on the hardware and software (software is manufacturer prepared programming aids designed to help the customer use the hardware quickly and efficiently with a minimum of effort) of electronic data processing systems is scheduled for initial publication in March 1962. STANDARD EDP REPORTS will be the first derived data service of its kind for electronic data processing users. It will be similar to the looseleaf information services that have become keystones of current knowledge in law, in accountancy, and in engineering. The service, under the imprint AUERBACH/BNA, will be prepared and edited by Auerbach Corporation of Philadelphia, and distributed by The Bureau of National Affairs, Inc., 1231-24th Street, N.W., Washington 7, D. C.

The new service is unprecedented in the scope and depth of coverage in the electronic data processing field. It is designed to help users of computers select equipment and software and to keep abreast of the state of the art and to provide manufacturers and sellers of equipment and consultants in the field, as well as users, with objective measurements of capacity, performance, and other specifications of all United States commercially available computer systems, peripheral equipment, and software.

STANDARD EDP REPORTS will present precise, uniform data that is explicitly detailed and standardized to an extent heretofore unobtainable. The service also will provide several features making the data more meaningful to subscribers with different levels of technical expertise.

The information service is not only reportorial, but also evaluative. It will provide measures of EDP system performance on standard tasks. In addition, reliable software data, heretofore relatively unobtainable, are being made an integral part of the EDP systems analysis. A third feature is the periodic publication of state-of-the-art reports which provide an authoritative context for making technical decisions based on the data in the reports. Finally, the decision making process itself is aided by a complete methodology for analyzing individual EDP selection problems and using the data in the STANDARD EDP REPORTS to find a satisfactory match of EDP equipment and software systems.

The present proliferation of computers has made the need for such derived data acute. Current and prospective users are hard-pressed to know and remember the names and model variations of all machines they must survey and to keep up with frequently-changing equipment specifications, few of which are directly comparable. Expert analysts and consultants in the data processing industry find that they and their staffs spend many man-months of effort deriving meaningful characteristics that can be compared, and measuring performance data on various computer systems. STANDARD EDP REPORTS will provide such analyses at a fraction of the cost of an equivalent staff project.

For each computer system commercially available, AUERBACH/BNA's STANDARD EDP REPORTS will provide rigidly standardized information with respect to software and hardware. For all computer users, software is of critical importance: a computer does nothing without proper programs. STANDARD EDP REPORTS will contain a complete analysis of the program packages available with each system such as source languages, translators, and operating systems. In the hardware area, the following are covered: data structure; internal storage; the central processor; input-output units; systems configuration; simultaneous operation; and physical characteristics. A series of equally comprehensive reports will cover peripheral devices independent of systems.

The performance of each system will be measured and reported in a systems performance section. Full information will be provided on prices--purchase and rental--for both the equipment and its associated services, such as maintenance and training.

In STANDARD EDP REPORTS, charts using rigorously defined terms will be used to permit quick evaluation of the significant features and performance of all machines of a given class or category. The applications-oriented measures of performance indicate the true value of special features, such as multi-programming, faster memories, "push-down lists", by presenting realistic "apples-to-apples" comparisons. Standardized charts are provided not only for computer systems, but for various kinds of peripheral equipment.

In providing a methodology for use of its data, STANDARD EDP REPORTS is oriented throughout to the needs of prospective buyers or renters of EDP systems. To assist users in defining their requirements, step-by-step questionnaires, forms, and formulae are provided in an extensive section on how to select a system. Complete directories of manufacturers and computing centers, and a glossary of terms, are included. For present computer users, the series of guide-line reports, providing information and technical commentary on the state of the art, should be especially valuable. Regardless of the variation in the level of their experience, the various elements of the methodology will enable all users of the service to examine the EDP selection data in an orderly progression and with appropriate weighing of the factors.

Contents of the service are being prepared by Auerbach Corporation of Philadelphia, a leader in the field of information sciences and technology, internationally known for its depth of experience in systems engineering, equipment design and development, operations research, programmed teaching, programming, business systems consultation, management sciences (industry and corporate analyses), and product and market planning.

The production and marketing of STANDARD EDP REPORTS will be handled by The Bureau of National Affairs, Inc., long a leading publisher of information services in the fields of law, taxes, labor relations, and government regulation.

Scheduled for initial publication March 15, 1962, STANDARD EDP REPORTS will be supplemented monthly thereafter. Eventually, the service will comprise four loose-leaf binders kept up to date at all times by means of supplemental and replacement pages.

AUTOMATION AND EDUCATION

Weekly Lectures for Business Machines Classes

Following is the eighth in an series of weekly lectures for business machines classes. The previous seven lectures have appeared in past issues of the SABE DATA PROCESSOR. Business teachers can use the ideas expressed in these lectures in many classes other than machines classes; the ideas are applicable to any business situation in which a system-machine relationship exists.

There are two lectures remaining, and these will be published in the January and February issues of the SABE DATA PROCESSOR. The ninth lecture will be on "Other IDP Common Language-Systems Relationships," and the tenth will cover "EDP Machine-Systems Relationships."

8. Punched-Paper Tape Accounting Machines-Systems Relationship

by E. Dana Gibson, Professor of Office Management, San Diego State College

In previous discussions, you have seen how increasing mechanization has helped solve business problems. By and large, these have been done on more complex machines that did the job somewhat faster, more accurately, and with less effort. With the advent of the accounting machine, it was possible to "write" several records at one time and capture vertical and horizontal totals for proof or statistical purposes. This increased the efficiency of a worker one or two times since he didn't need to add up these columns, make the additional records separately, and/or spend time hunting for the additional errors this method created.

But even this advanced method of handling accounting data left much to be desired. More errors than were desired still occurred. Any statistical relationships could only be shown by further handling of the figures involved by some human being. It took a lot of time to do this extra work. With the advent of common language media and devices, a big step forward was taken because most of the data needed for later statistical purposes could be captured during the original handling of the source data. New machines make it possible to obtain automatically from the common language media (punched cards, punched paper tape, etc.) all the reports, the updating, the completed forms, and similar desired information. This can be done at speeds far greater than before, more easily, and more accurately. The objectives of IDP (Integrated Data Processing) had been achieved by the development of a system which eliminates all repetitive handling of data by capturing it at its source on some common language media.

One of the machines that has been converted to a common-language machine is the Monroe President Accounting machine. Most adding and calculating and bookkeeping machines have been so converted. But let us examine how the Monroe President machine has helped the businessman do his work better when put into an accounting system.

Bank Savings Operation. In many banks today, using an NCR 2000 window posting machine, a ledger card and a pass book are posted side-by-side simultaneously. In the bank being discussed, it was determined that certain problems needed solving under this method:

1 The time needed to post the ledger card and the pass book needed to be reduced from its present average of 46 seconds.
2 If errors were made, they had to be found and corrected--usually a long process.
3 Business had increased to the point where the window clerks had no time to post during the day and this had to be done at night, necessitating added costs. Also, records were not available until after the posting had been done.
4 Interest had to be figured separately, causing more work and time.

By getting a new Monroe President punched-paper tape accounting machine system, the following things were accomplished:

1 Certain selected data is captured on punched paper tape automatically during the posting process: account number; kind and amount of the transaction; some key to the type of transaction made (deposit, withdrawal, etc.); and the balances involved.
2 This punched-paper tape is run through a tape-to-card converter which puts the data on the paper tape onto punched cards.

3 The new cards are collated with the old cards (that contain the up-dated information from the last period) to produce new up-dated cards for the current period.

4 The cards can be used to figure the interest automatically as part of the updating process.

5 Totals are proved by balancing with cash.

6 The punched cards prove themselves.

7 The conversion to cards from punched paper tape can be done at any time the tapes and the machines are available, so that much previously lost time can be saved. It also speeds up the whole process, as this work is often done immediately. Usually this work is off-line work; i.e., it doesn't tie-up all the other machines since it can be done as a separate job.

It should be pointed out that not all the work is done by one of these machines. Certain duties may always be more quickly and cheaply done by hand. If a large number of punched cards must be sorted to select only a few cards to process, it is faster, easier, and cheaper to visually run these down in the files and pull them for insertion into the machines which will update them. Experience will soon show which jobs should be run through a machine and which should be done manually.

Potash Mining Example. A potash mining company found that its payroll work was becoming overwhelming. It had a mine some distance from Los Angeles where the home office was located. All checks were figured and made out and the records kept at the mine, although they had to go to the home office for checking and other purposes. Quite a staff was needed to do this work and the job was getting out of hand.

It was decided to try a Monroe President Accounting machine. The time card produced at the mine was used to produce a punched paper tape which showed the clock number, the work order number, the main account number, the sub-account number, the men doing the job, the time involved, etc. This tape data was sent to Los Angeles over a wire by means of a transceiver. When the data arrived at Los Angeles it was used to produce checks. As this tape was produced on the Monroe President at the mine, the tape produced was transmitted directly to the home office without waste of time. Thus, all the records were kept at the home office, the amount of work was reduced so that fewer workers were required, the work was done faster, and the work involved fewer errors than before.

In The Future. One of the costly and time consuming operations is for the punched paper tape to be converted into punched cards so that the checks can be prepared. Monroe, and other companies, are beginning to produce equipment that can do some of this work directly from the tape. Monroe recently placed on the market the Distributape. Punched-paper tape can be fed directly into it and it will print out on a printer selected data in the manner desired. All operations cannot yet be done on a Distributape, but it is a step toward freeing punched-paper tape from the slavery of being tied to the apron strings of punched cards. Most computers, where they can be afforded, are also doing the same job. Computers can take the data on punched-paper tape, rearrange it, update it, or do whatever else to the data that may be necessary. However, this work is more costly and may take a highly skilled operator to program the computer. In any case, capturing data at its source (as it is first handled) on some common-language media (punched-paper tape in this instance) which can be handled quickly, accurately, and relatively cheaply, is what can be expected in accounting and many other business operations.

Automation Workshops

In the last issue Dr. Gibson started his new series based on his experiences in conducting Automation Workshops. Outlines for one- and two-day automation seminars were given. The following article continues the series:

How to Conduct Automation Workshops, Part 2
by E. Dana Gibson, Professor of Office Management, San Diego State College

5. Three-Day Automation Workshop. This course will consist of a series of regularly scheduled class, preview, and work sessions. Daily reading assignments, classwork, and preview schedules are listed below.

6. First Day, The Meaning of Data Processing: Systems, I:S&M, and IDP.

1 Assignment
- a Read appropriate articles from one or more of the following (your instructor will have these on file somewhere for your use):
  1) OFFICE EXECUTIVE 31:13, May 1956
  2) BASIC STEPS TOWARD AUTOMATION OF BUSINESS SYSTEMS, by Moore Business Forms, Inc. (a booklet)
  3) P. B. Garrott, INTEGRATED DATA PROCESSING BRINGS AUTOMATION IN PAPER-WORK, a booklet by Standard Register Co. in the form of a Special PS Report
  4) AUTOMATED DATA PROCESSING by Moore Business Forms, Inc., a booklet
  5) Duplicated papers: (see previous issues of the SABE DATA PROCESSOR, "Weekly Lectures for Business Machines Classes")
     a) "The Meaning of Systems"
     b) "The Interrelationship of Systems and Machines"
     c) "Other Common-Language-Systems Relationships"
- b Learn the meaning of the first 10 concepts on the attached concepts list

2 Classwork
- a Discussion of: Systems; Charting; Time and Motion Study; Work Flow and Layout; Forms Design and Control; Interrelationship of Systems and Machines; Integrated Data Processing; and How the above can be used in business classes

3 Lab work
- a Show the following audio-visual aids:
  1) INTRODUCTION TO PROBLEM SOLVING BY PAPERWORK SIMPLIFICATION, Standard Register Co., 10 minutes, sound filmstrip
  2) IDP, Standard Register Co., 35 minutes, 16 mm, color
  3) AUTOMATION IN TODAY'S MODERN OFFICE, Friden, Inc., 49 frame filmstrip with script to be read by instructor
  4) THE LANGUAGE OF THE SIXTIES, A. B. Dick, sound filmstrip with 33-1/3 record to be played on Dukane Projector and record player
  5) IBM ACCOUNTING MACHINE FUNCTIONS, a filmstrip with script to be read by instructor (on punched card equipment)
- b Discussion of each student's questions or plans for data processing in his or her classes

7. Second Day, Electronic Data Processing

1 Assignment
- a Read appropriate articles from one or more of the following:

1) OFFICE EXECUTIVE 31:5, 16, 19, 22, 26
2) Two offset papers: (NOTE: Do not copy published material without first obtaining permission)
   a) "Punched Cards Are Dying" by Stanley Miller
   b) "Punched Cards Are Here to Stay" by Erwin Brenman
3) Dittoed Papers:
   a) John Diebold, "Industry and the Automated Future," COMPUTERS AND AUTOMATION, February 1957
   b) Alred M. Cooper, "Automation Demands Perfect Communication"
   c) Glenn E. Hagen, "How Common Language Units Stimulate the Flow of Data"
4) Richard G. Canning, "Consolidated Files," a mimeographed paper

2 Classwork
- a The meaning of EDP and EDP Systems
- b The difference between Data Processing, I:S&M, IDP, and EDP
- c Computer systems: small, medium, large
- d Effect of automation on Office Work and Personnel
- e Where and how to obtain education about automation
- f How to integrate the above into business teaching

3 Lab work
- a Show the following audio-visual aids:
  1) AUTOMATION, from Edward R. Murrow's SEE IT NOW program on CBS, 16mm, 84 minutes
  2) CENSUS 70: VA U2012, Remington Rand, 16mm, 14 minutes, b&s
  3) THE COMPUTER COMES TO MARKETING, Fortune Films, 16mm
  4) THIS IS AUTOMATION, General Electric Co., 16mm, 25 minutes
- b Discussion of each student's questions or plans for data processing in his or her classes

8. Third Day, The Future of Automation, OR, and Programming

1 Assignments
- a Look over any material available, as time permits, on above topics
- b Learn the third set of ten concepts on attached concepts list

2 Classwork
- a The future of automation and Operations Research
- b How that future is likely to affect business teaching
- c Programming: What it is, How it is done, and what it is likely to be like in the future

3 Lab work
- a Discussion of each student's questions or plans for data processing in his or her classes
- b One hour objective test

9. AUTOMATION CONCEPTS LIST

1 System
2 Motion Study
3 I:S&M (Interrelationship of Systems and Machines)
4 Form Design and Control
5 Work Flow and Layout
6 Common-Language Media
7 IDP
8 Optical Scanning Systems
9 Magnetic Ink Systems
10 Punched-Paper Tape

11	EDP	16	Computer Systems
12	Automation	17	Programming
13	EDP Systems	18	Computer Memory
14	Service Bureau	19	Computer Input
15	Programmer	20	Medium-sized Computer
21	Solid-State Computer	26	COBOL
22	Debugging	27	Binary
23	IBM	28	Operations Research (OR)
24	Flexowriter	29	Linear Programming
25	1401	30	Flow Charting (for programming)

10. One-Week Automation Workshop. Suggested textbook: Esther R. Becker and Eugene F. Murphy, THE OFFICE IN TRANSITION, Harper & Bros., New York. This course will consist of a series of regularly scheduled class and preview sessions. Assignments and class work are listed below, together with the films or filmstrips to be previewed during the scheduled preview times. A one-hour objective-type test will be given on the last day of the class. Grades will be assigned as follows:

Written assignments (due 4th day), 30% of grade
Previewed film (any three evaluations), 10% of grade
Final examination (one hour on last day), 60% of grade

Written assignments are to be turned-in as required below. About 10 films or filmstrips will be shown during the preview period, and must be written-up on the attached Evaluation Sheets. Any three of them may be used to satisfy this requirement, as long as at least one is a motion picture. They are due the fourth day of the class. Evaluation sheets to be used for additional evaluations can be obtained from your instructor. A student may preview all the films or filmstrips if he wishes. A final examination will be given the last hour of the final class session.

*To be continued in the next issue.

AUTOMATION AND EDUCATION

Automated Teaching

West Coast Conference and Exhibit on Programmed Learning and Teaching Machines
by Mrs. Lucille Meyers, Secretary-Treasurer, SABE

The American Management Association presented the first West Coast Conference and Exhibit on Programmed Learning and Teaching Machines at the Ambassador Hotel, Los Angeles, November 15-17, 1961.

Dr. Arthur Flemming, President, University of Oregon, opened the conference by re-emphasizing the need to improve the ability of students to communicate and by describing the shortage of qualified manpower as the most serious problem which our nation faces today. Dr. Robert Chapman, Ramo Wooldridge, Conference Chairman, presented basic information about programmed learning and teaching

machines. Dr. Robert Mager, Varian Associates, talked about learner attitudes toward subjects to be learned from teaching machine programs.

In the afternoon, Harold Moon, Manager, Programmed Instruction Unit, McGraw-Hill Book Company, prepared an auto-instruction program for the audience. Dr. Lloyd Homme, Teaching Machines, Inc., showed a group of slides illustrating the problems a programmer faces in dealing with specialists. Dr. Richard Hatch, who substituted for Dr. Crowder, Western Design, talked on the scrambled book or branching approach to program writing. Dr. Gilbert, TCR Education, gave his research on the Mathetics Programming Approach. Mathetics is defined as "to learn," a systematic method of planning the course of human learning. During the panel ways of dealing with individual differences were discussed.

Thursday morning's session was more dynamic and dealt directly with industrial training programs which utilize certain types of programs and machines. Dr. Leonard Silvern, Hughes Aircraft Co., described the complex interaction between man and machine and the performance system spectrum. Dr. Donald Cook, Basic Systems, talked on the role of auto-instruction in job-training, and Dr. Finn, University of Southern California, applied auto-instruction to elementary and secondary school education. He felt that educators should use "self-instructional" rather than "auto" or "teaching machine" terminology. Dr. Corrigan felt that programmed learning is a kind of systems analysis; he stressed that methods should not be confused with systems, as systems is the real power of the future.

Thursday afternoon's session covered the training of technicians by Dr. Holt, Bell Telephone Laboratories; the role of auto-instruction in teaching communications skills by Dr. Morton, University of Michigan; the CLASS system, a computer based teaching system by Dr. John Coulson, SDC; and the cost of doing the job by Dr. Margulies, Center for Programmed Instruction in New York City.

The last session took place Friday morning and gave case histories of four companies using programmed instruction: Recordak Corporation, Litton Systems, General Telephone Company of Santa Monica, and Schering Corporation.

Automation for Education

by Don D. Bushnell, Automated Education Project
System Development Corporation

The time is past when the coupling of a student to a computer for instructional purposes becomes a newsworthy event. That computer-based teaching machines are now tools of research in a number of public and private institutions is well attested to by the papers presented at the mid-October conference on the application of digital computers to automated instruction, held in Washington, D. C. The importance of this research in the planning of future educational data processing systems should not be overlooked, for it is quite feasible that the real-time system used for data processing and for information storage and retrieval in our schools will also be capable of adapting auto-instructional programs to individual students' needs and abilities. This may be possible in the relatively near future.

Machine Responsiveness to Student Learning Behavior. The potential of the computer for handling individual student differences in learning rate, background, and aptitude seems to be of primary interest to most researchers working with automated teaching systems. Machine responsiveness to student learning behavior can be achieved by a technique of branching the student forward or backward through subject materials primarily on the basis of his response to questions of content seeded throughout the course. However, reasons for branch-

ing can be many and varied (sometimes depending upon the sophistication of the equipment and the programmer). This pre-programmed criterian for branching usually includes one or more of the following:

1 Characteristic of student response--promptness and definitiveness of reply

2 Nature of response--was it right or wrong? what specific errors were committed?

3 History of student learning behavior--previous response pattern, problem areas, reading rate

4 Relevant student personnel data--IQ, sex, personality variables, aptitudes

5 Nature of subject matter

6 Degree of student motivation

7 Student generated requests for re-routing

These are but some of the important variables explored in the research activities abstracted below.

Conference on the Application of Digital Computers to Automated Instruction. This conference brought together computer scientists and educators interested in developing the potentiality of the computer for instructional purposes. For three days, invited papers were presented by researchers from a variety of public and private institutions. Some papers were theoretical or predictive in content, however, only those studies reporting some actual utilization of the digital computer are included herein:

1. University of Illinois. "PLATO II: A Multiple-Student Computer-Controlled Automatic Teaching Device," paper presented by W. W. Lichtenberger from the Coordinated Science Laboratory.

PLATO (Programmed Logic for Automatic Teaching Operations) is the name of a research project using an ILLIAC computer-controlled system of slides, TV display, and student response panel for simultaneously instructing two students in either mathematics or French. The uniqueness of the PLATO II system lies in its input flexibility and the degree of control the student has over the sequences of educational materials he sees for study. When questioned on the content of material viewed on the TV screen, the student can transmit his answers in numbers, words, sentences, or algebraic expressions. The ILLIAC displays each character selected by the student in the blank space appearing with the question on the television screen. By pressing a "judge" button, the student causes the computer to write either "OK" or "No" next to his answer. If wrong, the student has the capability of asking for additional help to which the computer responds by selecting simpler but related material until the student presses the "Aha" button and is returned to the question missed.

PLATO II, although fashioned after the model of the human tutor, has only a limited degree of adaptability to student requests. If the additional "help" routines of three or four slides are not sufficient to clear up problem areas, there is nothing else to be done but give the student the right answer and let him proceed. However, richer variable routines are apparently in design. Some means of branching on the basis of specific errors made in a wrong response, the number of wrong responses submitted for a given concept, and how much help was required to complete a given item are also being explored.

According to an announcement by the Coordinated Science Laboratory, PLATO will ultimately be modified to teach many students at the same time.

2. Bolt, Beranek and Newman, Inc. "Preliminary Experiments in Computer-Aided Teaching," paper presented by J. C. Licklider.

A Digital Equipment Corporation PDB-1 computer has been programmed to control two typewriter stations for instruction in language vocabulary drill. The computer types out a word from a set of German words. The student responds by typing a corresponding word in English. If the response is correct, the computer confirms its correctness, posts a hypothetical score, gives a compliment, eliminates the word from the set, and presents a new word from that set. If the student has been incorrect, the computer says "No," moves the item to a missed set, and offers him the choice of trying again or seeing the correct answer. When the student has finally replied appropriately, the computer posts a score, makes a suitable remark, and presents the next item in the sequence or a missed item from an earlier set.

This research uses the computer to simulate only limited machine responsiveness to errors committed by students. Licklider contends that concern with the hardware (displays, controls, and procedures) is more effective in facilitating learning than adherence to certain learning principles derived from the psychological laboratories.

3. Thompson Ramo Wooldridge, Inc. "Computer Techniques in Instruction," paper presented by R. L. Chapman.

Thompson Ramo Wooldridge has developed an auto-instructional device with a control system which is smaller and less expensive than a general-purpose computer but which incorporates a large amount of operational flexibility. This device, called MENTOR, provides both visual and auditory display capabilities for training one student at a time. The student responds through push buttons and is given immediate knowledge of results. MENTOR can branch on the basis of single questions, cumulative performance scores, or response time latency. It keeps a record of frame sequences, student responses, and student response times.

One prototype of MENTOR has been built for research. However, no research with this unit has been accomplished to date although a long term program of activities has been drawn up.

*To be continued in the next issue.

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